

## Response to the Editor

### Editor

Public justification (visible to the public if the article is accepted and published):

Dear Dr Lu and co-authors,

I am happy to report that I received two reviews on the revised version of your manuscript. Both reviewers are quite happy with your revision. Although one reviewer recommended technical corrections only (and the other recommended "accept as is"), I'd like to ask you for a minor revision of your manuscript regarding the following issue raised by reviewer #4:

"In Section 3 the differences between ERA5 and SWOOSH are discussed in one sentence just pointing on the moist bias. This is too less and the discussion should be extended."

Please provide some more description/discussion on the differences of these methodologically very disparate data sets, and how these differences are relevant for your analysis. So far, the only statement in this respect is:

"SWOOSH and ERA5 display consistent distribution of stratospheric water vapor: .... The largest difference between two datasets is the wet bias around 0.3 ppm at the tropopause (Krüger et al., 2022)." What about seasonal cycles, their phases and amplitudes, longer-term trends, inter-annual variations?

Actually, this issue was already raised in one of the reviews of the previous version of your manuscript. Please consider also all other comments on technical issues by reviewer # 4 and revise accordingly.

The revised version of your manuscript will not be sent to reviewers again, but will be reviewed by me (editor) only.

Sincerely,  
Gabriele Stiller

Response:

Dear Prof. Gabriele Stiller,

Thank you for your handling our manuscript in the several rounds of reviews. We have carefully studied the comments from all of our reviewers in all rounds. In this round of revision, we further incorporated the concerns from the last reviewer.

Especially, we have provided a detailed description of the water vapor differences between ERA5 and SWOOSH in the annual mean and individual seasons, and have pointed out the differences in their vertical distributions in Section 3a. Long-term trends

and amplitudes are analyzed in detail in Section 3b.

“The wet bias is located at 70 hPa in the annual mean and summer mean, while the wet bias is located at 100 hPa in the winter mean. Meanwhile, in the tropical upper stratosphere and above, the water vapor increases with altitude more slowly in ERA5 than in SWOOSH. In the upper stratosphere, ERA5 exhibits a dry bias.” (L160-163)

Thank you once again for your kind help to improve the quality of our paper.

Yours,  
Sincerely,

Qian

## Response to the Reviewer

I would like to thank the authors once again for taking my comments and suggestions for improvement into account. I only have a few technical corrections that should be considered before publication in ACP:

Response: Thank you for your comments concerning our manuscript. We have studied the comments carefully and made corrections which we hope meet with approval.

A question on the ERA5 time period used. In the main text it is written that 1960-2020 has been considered, but in the figure captions the time period is given as 1959-2019. This is inconsistent and this inconsistency should be removed.

Response: The ERA5 time period was changed to “1959-2019” in the main text. (L94, L125)

In Section 3 the differences between ERA5 and SWOOSH are discussed in one sentence just pointing on the moist bias. This is too less and the discussion should be extended.

Response: discussion has been added here.

“The wet bias is located at 70 hPa in the annual mean and summer mean, while the wet bias is located at 100 hPa in the winter mean. Meanwhile, in the tropical upper stratosphere and above, the water vapor increases with altitude more slowly in ERA5 than in SWOOSH. In the upper stratosphere, ERA5 exhibits a dry bias.” (L160-163)

L105: “combination observation from.....” I would suggest to rewrite this too “consist of observations from....”

Response: Changed. (L105)

L157: 199 -> 1992. The last digit of the year is missing.

Response: Changed to “1992”. (L157)

L193 and 194: m/s should be written as m s<sup>-1</sup> (with -1 in superscript)

Response: Changed. (L196, L197)

L227: positive, negative and positive -> positive appears here twice and one is obsolete.

Response: A sandwich pattern has three anomaly centers. It is correct here. (L230)

L231: Figure 5 -> Fig. S5 and “respectively” in the sentence should be omitted.

Response: Changed. (L234)

L331: Figure 9 -> Fig. 9

Response: Changed. (L334)

L331: “.....under the 30 hPa in stratosphere.”? Sentence not clear, please rephrase.

Response: Changed to “between 30–100 hPa”. (L333)

L336: space between “Fig.” And “9b” missing.

Response: Changed. (L338)

L337: Same here for “Fig.” and “S6”.

Response: Changed. (L338)

L338: Same here for “Fig.” and “9c”.

Response: Changed. (L340)

L343: What is meant with “residual item”? Do you mean the air that is transported by the residual circulation. Please rephrase to be more clear.

Response: Changed to “The residual item, including the net chemical production, the evaporation and sublimation, and the condensation and deposition, also exhibits negative water vapor anomalies in the tropical lower stratosphere (Fig. 9h).” (L344-346)

L371: Remove “in” and put “Fig. 10” in parentheses and make the same adjustment for Fig. S8.

Response: Changed. (L373-375)

L397: Full stop after “et al” missing -> et al.

Response: Added. (L399)

L403: m/s -> ms<sup>-1</sup> (with “-1” in superscript)

Response: Changed. (L405)

Figure 11 caption: “(a)” missing before “northern summer”.

Response: Added. (L421)

L421: discussions -> discussion

Response: Changed. (L423)

L422: Don’t call it the “the water vapor QBO phenomenon” it is rather the representation of the QBO in the water vapour distribution.

Response: Changed to “...the representation of the QBO in the water vapor distribution”. (L424-425)

L430: regularl -> regularly

Response: Changed. (L432)

L439: “in relevant literature” -> change to “previously” so that it reads “has been shown previously”. Generally, the sentence should be improved and the statement made here more clearly formulated. You mean that the previous studies considered a much shorter

time period for their analyses as used in this study.

Response: Changed.

“Although this conclusion has been shown previously (Tian et al., 2019; Wang et al., 2020), previous studies considered a much shorter time period for their analyses than that used in this study.” (L440-442)